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On the stability relations of hydrous minerals in water-undersaturated magmas

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ABSTRACT

Reaction of a hydrous mineral with a water-bearing silicate melt is analyzed in terms of the stoichiometry of (in)congruent dissolution. Application of the law of mass action provides an explanation for the presence of an isobaric thermal maximum that manifests itself in terms of enhanced stability of the phase under conditions of water undersaturation. It is shown that the water content of the melt at which the maximum develops is independent of pressure and water speciation, but is strongly dependent on the identity of other ("anhydrous") melt species and upon the stoichiometric numbers of additional solid phases involved in the reaction. Utilizing MELTS, the analysis is applied to the cummingtonite-bearing rhyolitic magmas of the Taupo volcanic zone of New Zealand.